CIF 22-7: Investigation of Lunar Regolith Reduction via Hydrogen Plasma in Different Plasma Environments

Project PI: Kenneth Engeling (kenneth.engeling@nasa.gov)

Initial PI: Elspeth Petersen (elspeth.petersen@nasa.gov)

Team Members: Ryan Gott (ryan.p.gott@nasa.gov), Carolina Franco (carolina.franco@nasa.gov), Jason Fischer (jason.a.fischer@nasa.gov), Joel Olson (joel.a.olson@nasa.gov), and Tracy Gibson (tracy.l.gibson@nasa.gov)

Activity Type: New Start

Primary STMD Taxonomy: TX07.1.3 Resource Processing for Production of Mission Consumables

Start TRL: 2 **End TRL:** 3

Executive Summary: The team at NASA KSC explored the use of hydrogen plasma as a reducing agent for Lunar regolith simulant in order to prove the viability of oxygen extraction from oxides. The focus of this work was to investigate the hydrogen ion production of different plasma power sources. An optimization trade study was completed by maximizing the production of the hydrogen ion and comparing the amount produced to the energy consumed. Hydrogen ion production was determined via residual gas analysis and a rough calibration using injected water. The hydrogen ions reduce the oxides present in the Lunar regolith, forming an OH molecule, which can further react with the hydrogen environment to form water vapor. This water vapor can then be measured through a residual gas analysis. Through this study, it was found that a direct current (DC) glow discharge operating at approximately 1 torr in a hydrogen environment produced the largest amount of reduced regolith when compared with a nanosecond pulsed system and alternating current (AC) source. Radiofrequency devices beyond AC were not studied in this work. Although the DC source performed the best here, limitations in design and experiment setup/scalability may lead to the selection of an alternative plasma power source in the future.